

A GUIDE TO THE GEOLOGICAL GALLERIES OF THE INDIAN MUSEUM

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A GUIDE TO THE GEOLOGICAL GALLERIES OF THE INDIAN MUSEUM, CALCUTTA

PART I

Current news

Meteorite gallery

Mineral & Rock gallery

PART II

Siwalik gallery

Fossil Invertebrate gallery

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PART I

BY :

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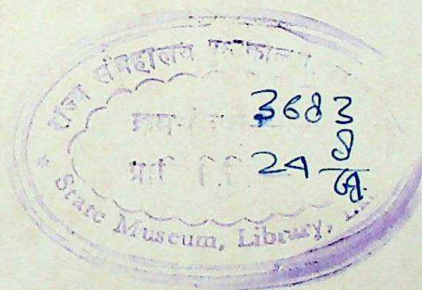
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I. INTRODUCTION

The Indian Museum, an offshoot of the Asiatic Society of Bengal set up in 1784 by Sir William Jones, came into existence during the last quarter of the 18th century. Its purpose was to display history and art of the East. Later, during the year 1814 Dr. Nathaniel Wallace, a Danish Botanist, the then Curator of the Museum grouped these into two main divisions, viz., (a) Archaeological, Ethnological and Technical and (b) Zoological and Geological.

"In 1858 the establishment of Geological Museum was amalgamated by the order of the Government of India, with that of the Geological Survey, and the Museum was definitely incorporated into the latter Department, of which it has ever since remained an integral part.....

....It was not until 1875, however, that the geological collections belonging to the Geological Survey could be moved to the present building in Chowringhee; the old quarters in Hastings Street were vacated on the 30th September in the same year, on the 1st January, 1877 the new galleries were thrown open to the public" (The Indian Museum 1814-1914, pp. 57 and 59).

The Geological Survey of India through Curators has been in charge of the maintenance and up-keep of the Geological galleries. This work has been continued by successive Curators of great repute and zeal from the staff of the Geological Survey of India.

The collections displayed in the Geological Galleries, is a national treasure, accumulated by the scientific work of the Geological Survey of India, the third oldest Geological Survey in the world.

The collections belonging to the Geological Survey of India are arranged in four galleries situated in the Northern wing of the Museum building. On the ground floor to the north of the entrance hall, is the Vertebrate Fossil Gallery, known as the

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'Siwalik Gallery' and on the far side of this to the north, is the Meteorite Gallery. Leading off from this gallery again, to the east, and on the northern side of the open quadrangle are the mineral and rock collections arranged in one large gallery. On the first floor, immediately above the Mineral and Rock Gallery, is the Invertebrate Fossil Gallery. Over 30,00,000 specimens belonging to the Geological Survey of India are housed in these four galleries, and more than 80,000 of them are exhibited.

In this guide, the various exhibits shown in the galleries are briefly described.

II. CURRENT NEWS

Near the entrance to the Geological Galleries the visitor will find a feature under the caption "Mines are the Sources of the Treasury" (Kautilya) highlighting important current news about the mineral development in the country and rapid strides in dis-

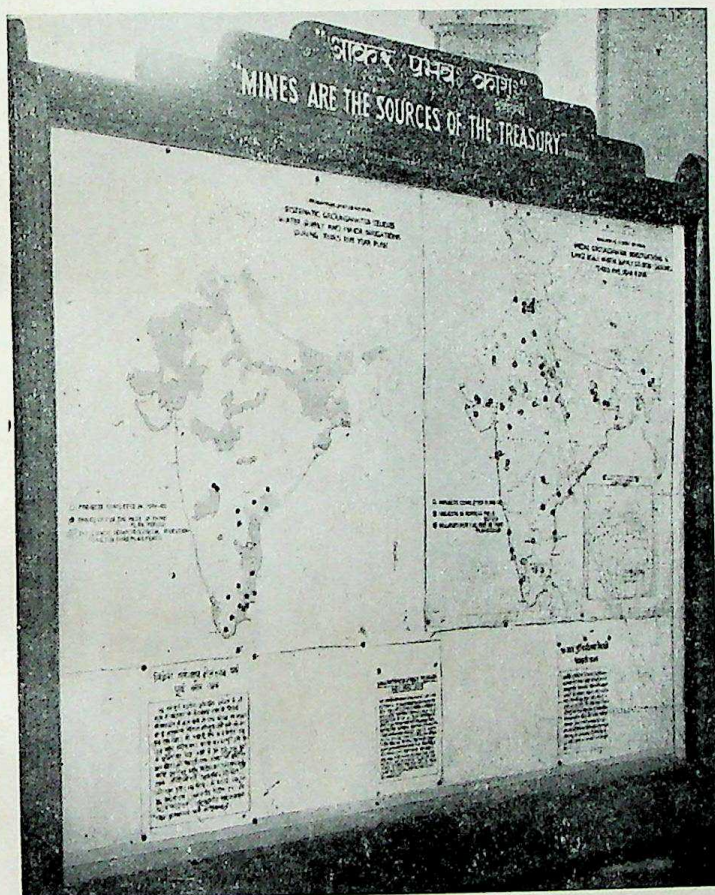


Fig. 1—A show-case meant to highlight important current news about mineral development in the country and rapid strides in discovery of new minerals by the G.S.I.

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covering new minerals by the Geological Survey of India
(Fig. 1). This has been introduced in the Museum in 1960,
with a view to bringing to the notice of the public the important
background of scientific information regarding minerals in a simple
and diagrammatic way. Thus maps, charts, diagrams and short
descriptive notes in English, Hindi and Bengali, along with speci-
mens are being displayed. Some of the features put on display
were (i) Iron ore deal with Japan by the Govt. of India, (ii) Dis-
covery of oil in Cambay and Ankleshwar, Canada-India Reactor
critically attained, (iii) Discovery of new coal seam in Singrauli
area, (iv) Recent finds of coal by the Geological Survey of India
in Raniganj and Ramgarh Coalfields etc.

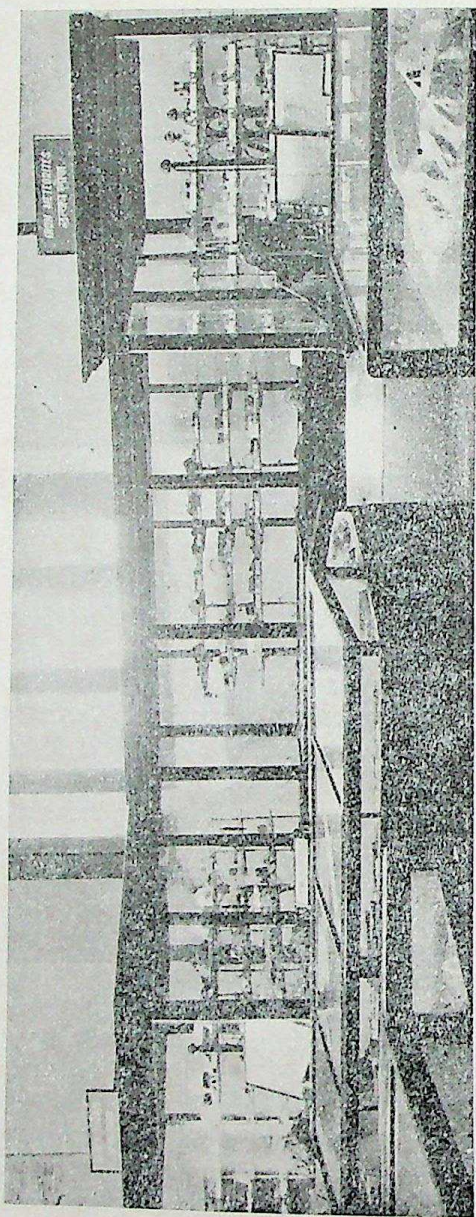
III. METEORITE GALLERY

After the Siwalik Gallery the visitor enters the Meteorite Gallery situated on the northern side of the Museum. This gallery, besides accommodating meteorite collections, has show-cases containing a variety of exhibits which include precious and semi-precious stones, ornamental building stones, and exhibits illustrating well-established geological principles viz., the present is the key to the past, illustration of principles of physical geology by means of specimens, introduction to mineralogy, field equipment used by geologists, models of dam sites, model of rig in use in oil field, relief map of India, etc.

A. INTRODUCTION TO FUNDAMENTALS OF GEOLOGY

As the visitor enters the gallery, the first show-case to the left depicts the dictum, "The present is the key to the past". Specimens of rocks showing ripple marks and current bedding of the past geological times are displayed.

The next three show-cases consist of specimens illustrating physical geology. A beautiful specimen of a stuffed bird shows encrustation with carbonate of lime; this has been formed by allowing water from a calcareous spring to drip over it for a month; similarly the leaf displayed shows encrustation of carbonate. The effect of variation of temperature is illustrated by a rock specimen from Arabia which shows shattering due to expansion and contraction because of great differences in day and night temperature. Action of wind has been illustrated by wind-blown pebbles of limestone and a wind-polished pebble from Rajasthan desert, the edges of which have got rounded. Effect of weathering by rain-water can be seen on pebbles of limestones. The capacity of subsurface water to dissolve silica and re-deposit is well-illustrated by the formation of chert concretion in shale in a specimen from Gwalior. Some minerals assume the form of others by processes involving alteration and substitution, this phenomenon is known as pseudomorphism. The hexagonal prism displayed is a magnetite



Meteorite collections are shown in the large show-cases in the back-ground. The ornamental building stone and a portion of precious and semi-precious stones are seen in the left foreground and a model of Barren Island Volcano on the right hand side.

pseudomorphous after apatite; the cubic crystals of limonite are pseudomorphous after pyrites. Several other geological phenomena are well-exemplified in the specimens displayed which illustrate contact effects by hot magma or liquid rock, jointing, lamination, foliation, ripple marks, etc.

The study of minerals is well-illustrated in the next four show-cases under the caption "Introduction to Mineralogy". Wooden models of the crystals, along with minerals occurring in nature in definite geometrical shapes *viz.*, Cubic, Tetragonal, Hexagonal, Orthorhombic, Monoclinic and Triclinic, are displayed.

Minerals are also characterised by specific physical properties. One show-case is devoted to illustrate physical properties such as colour, lustre, fracture, cleavage, taste, tenacity, hardness, fusibility and odour, as also optical characters.

Opposite to the show-case described above, typical specimens of rocks have been displayed to explain what the crust of our earth is made of. Specimens of igneous, metamorphic and sedimentary rocks are displayed in one show-case. The next two show-cases deal with geophysics, geochemistry, groundwater, and engineering geology.

To the eastern side and adjacent to the above described arrangement the visitor may see the row of show-cases one of which contains equipment used by geologists during the course of their work. It contains geological hammer and chisel used for breaking and trimming rock specimens; specimen bags for collection of specimens, adhesive tapes used for labelling the specimen; pocket lens for on-the-spot examination of specimens; clinometer and bruntun compasses used for measurement of dip (inclination of geological formation), and strike directions (horizontal direction of the rock formation) and for taking other directions; steel and metallic tapes for measurement of precise lengths; and a number of items such as acid bottle, streak plate, haver-sack, torch, pencil and field notebook which are all used by geologists in the field to carry out the detailed studies. Some of the implements used in mountaineering by geologists such as ice axes, nylon rope and goggles are shown

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in the same show-case. In an adjacent show-case are shown topographic sheets, maps and aerial photographs which are also used by geologists.

B. PRECIOUS AND SEMI-PRECIOUS GEMSTONES AND ORNAMENTAL BUILDING STORES

The visitor will naturally be interested in the two show-cases containing over 1,400 of cut and uncut precious and semi-precious stones including rare and valuable gemstones, exhibited in the central part of this gallery. Amongst them are emerald from Colorado, a ruby from Burma and Sapphires from Kashmir and Ceylon. The opposite show-case contains ornamental building stones including several beautiful and colourful specimens of marbles both from India and abroad. The famous marble from Makrana, Jodhpur, which has been used for building the world famous Tajmahal, and the Victoria Memorial, Calcutta has been displayed. A casket carved out of Kaimur sandstone from Gwalior, Madhya Pradesh may also interest the visitor.

C. DAM-SITES

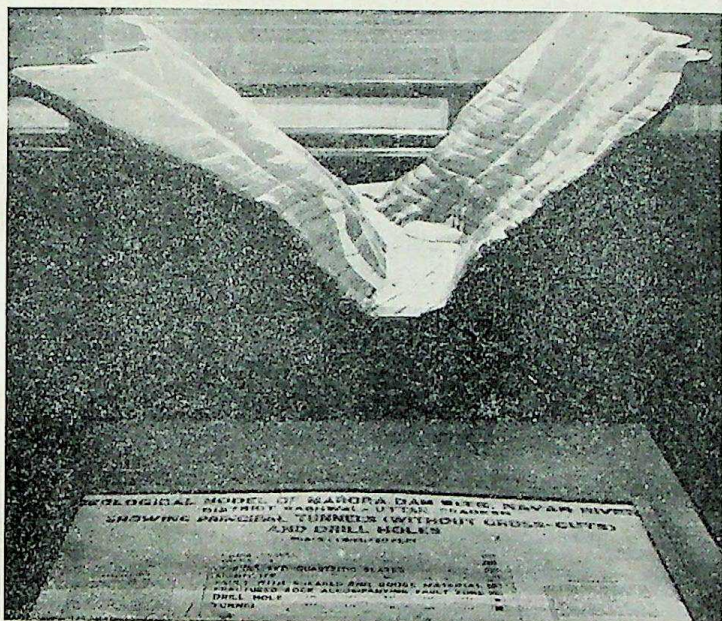
Geological models of Kosi (Nepal) and Marora (Uttar Pradesh) dam-site have been displayed in the central portion of the gallery to illustrate the importance of geological studies in the proper selection of dam-sites. In the case of the Marora dam-site, the surface feature did not show any fault or weak zone. However, exploration by diamond drilling showed the existence of a fault with a wide zone of crushed rock in the foundation running parallel to the river gorge. The models illustrate the exploration carried out by drill holes, tunnels and shafts.

D. OTHER EXHIBITS

On the southern wall of the gallery a large-sized relief cum geological map of India (horizontal scale : 1:10, 13, 760 or 1"= 16 miles; vertical scale : 1:99, 275 or 1"=1.57 miles) shows the location of important economic minerals in the country with the help of small colourful bulbs which glow separately for each mineral at intervals.

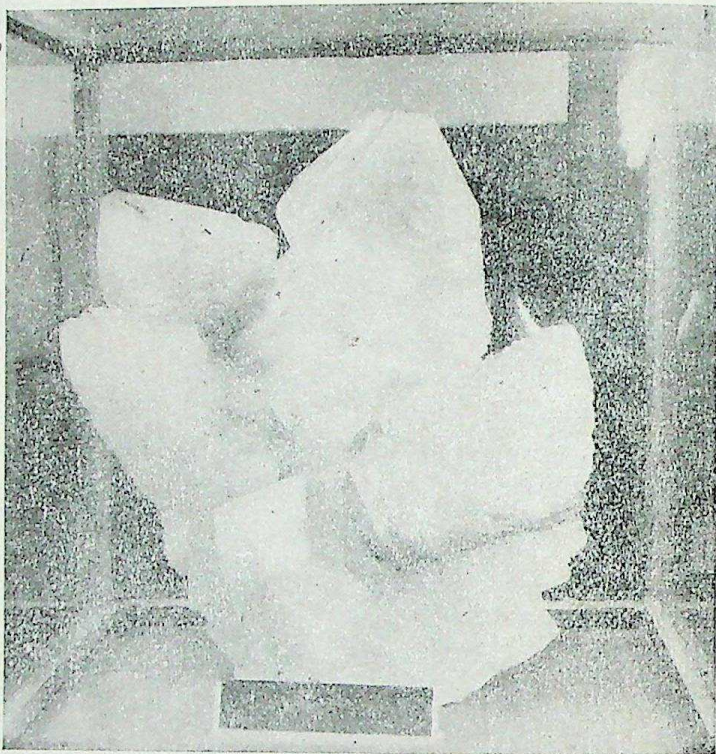
On the South-eastern corner of the gallery the visitor will find a model of a rig in use in oil-field with a diagram of an oil-well. Close to this are placed a large number of coal blocks from different collieries from our coal-fields.

On the eastern portion of the gallery a model of Barren Island, in the Bay of Bengal, has been exhibited. The native sulphur obtained from the island by the Geological Survey of India has been placed within the show-case.

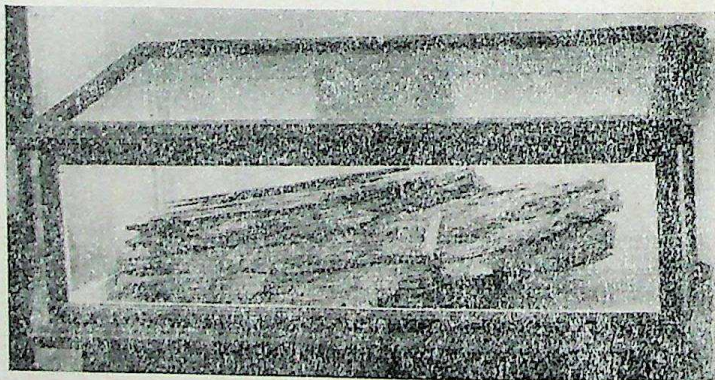


Geological model of Marora dam-site, Nayar river,
Garhwal district, U.P.

Other interesting exhibits in this hall are a large crystal of synthetic alum placed near the entrance to gallery, a beautifully carved marble-vase, a large-sized book of mica from Hazaribagh, Bihar, cubes and natural aggregates or crystals of rock salt from Salt Range, W. Pakistan, and asbestos cement and steatite products.



A crystal of synthetic alum.



A book of mica.

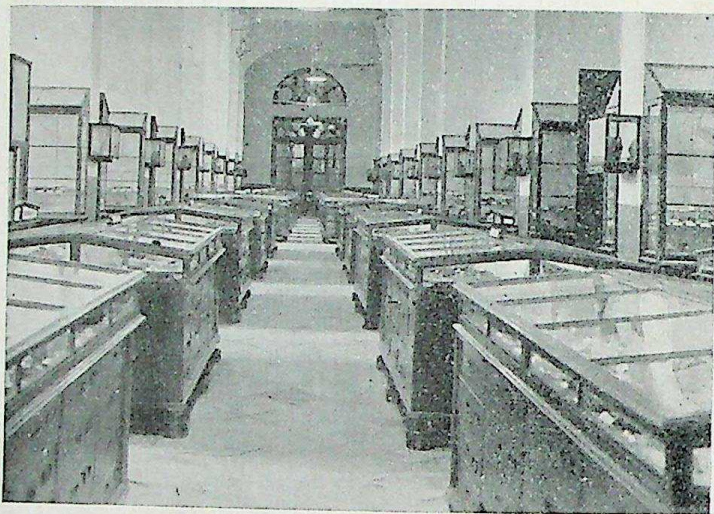
E. METEORITES

Meteorites, have their origin from the planetary bodies in the space around us and therefore, they interest scientists in the origin of the solar system. More recently they are being intensively studied, because of increased world-wide space research.

Three large-sized rectangular show-cases containing valuable collections of meteorites covering over 600 separate falls form the principal exhibit in the gallery. This has increased during the present century by exchange with Museums in other parts of the world, and by additional collections made from newly recorded falls. This collection of meteorites is the largest in Asia, and one of the most important in the world on account of the number, variety and rarity of the specimens, specially the carbonaceous meteorites which are extremely valuable in studies on the existence of life in outer space. A major portion of the meteorite collection has been scientifically classified on the basis of chemical composition, physical properties and mineralogy. All the meteorites have been broadly classified under two groups *e.g.*, Stones and Iron. The largest stone meteorite in the collection is part of the Merua (Allahabad district, Uttar Pradesh) fall (07.15 a.m. on the 30th August, 1920). Together with its other three small pieces, the meteorite weighs 56,687 grams. The largest iron meteorite is a specimen of the famous Canon Diablo Meteorites, found in 1891, weighing 38,669 grams. Many of the meteorites on display are from well described authentic falls.

IV. MINERAL AND ROCK GALLERY

From the Meteorite gallery the visitor enters the large gallery containing mineral and rock collections. At present there are over 60,000 rocks and 20,000 minerals.



A general view of the main mineral and rock gallery.

Near the entrance, the visitor comes across an interesting specimen—a flexible sandstone from Kaliaana, East Punjab; this is a remarkable rock that bends as can be tried by the visitor. The flexibility of the rock is due to the decomposition of the cementing material in between the particles of sand (quartz); the rock has thus become a mass of loosely inter-locking grains of quartz with wide interspaces round them which allow a certain amount of flexibility for the stone. Adjacent to this on display are two illuminated show-cases, one containing a large crystal aggregate of smoky quartz, from Switzerland and the other a large specimen showing crystal aggregates of zeolite from Maharashtra. Other exhibits at the entrance are a large-sized specimen of wood opal from Mt. Morision, Tasmania, a specimen of sandstone (Vin-

dhyam) from Panna, Madhya Pradesh and a map of the world as it was at the end of the Carboniferous period (nearly 200 million years ago).

About two-third of the area, of the western portion of the gallery has been classified into three parts. The central part exhibits important rocks and minerals of the present 16 States of the Indian Union. In the northern flank are displayed a large collection of typical rocks and minerals from different geological horizons in India from the oldest to the most recent. In the southern part minerals and rocks are arranged industry-wise. The remaining one-third of the gallery towards the eastern portion has been devoted to the exhibition of systematically classified minerals and rocks.

Along the central part of the gallery rocks and minerals are arranged state-wise with special emphasis on economic minerals. All the States, constituting the Union of India, viz., Andhra Pradesh, Assam, Bihar, Gujarat, Himachal Pradesh, Jammu & Kashmir, Kerala, Madhya Pradesh, Madras, Maharashtra, Mysore, Orissa, Punjab, Rajasthan, Uttar Pradesh and West Bengal, are included.

To have a glimpse of the stratigraphy-wise arrangement of minerals and rocks, the visitor will turn to the left from the Meteorite gallery entrance.

Stratigraphy is the chronological study of rocks, viz., the history of rock formations on the earth. This history has been classified into different chapters, each of them distinguished by its own characteristics. Broadly speaking stratigraphy of the world has been classified into five groups—Quaternary, Cainozoic, Mesozoic, Palaeozoic, Pre-Cambrian or Proterozoic, Archaean or Azoic in order of increasing antiquity. The oldest of the Archean group has been found to be even as old as 4,000 million years.

The sequence of arrangement under this plan is : (1) Charnokite series (2) Manganese suite of minerals and rocks (3) Dharwar System (4) Gondite-kodurite-khondalite series (5) Sausar-Sakoli-Chilpighat Series (6) Gangpur Series (7) Aravalli System

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(8) Iron-ore-Kolhan Series (9) Cuddapah System (10) Delhi System (11) Vindhyan System (12) Gondwana System (13) Jurassic of Cutch (14) Deccan Trap (15) Geological formation of the Himalayas.

Charnockite (named after Job Charnock, the founder of Calcutta whose tombstone is made of this rock) is the term applied to a group of Archaen rocks which have certain distinctive characters; these were first recognised and described in India. In Peninsular India charnockite forms high mountain masses like the Nilgiris, Palni and Shevaroy hills in Madras and extends from Orissa to Ceylon. The charnockite series of rocks have been classified into four divisions : acid, intermediate, basic, and ultra-basic. Specimens from the type areas of all the four divisions have been exhibited in the show-cases with the photographs showing their mode of occurrence. In the same cubicle the visitor will see show-cases containing the world famous manganese suite of minerals. India as is well known, has vast resources of manganese ores and minerals which have been studied in detail; eight manganese minerals including vredenburghite, sitaparite, hollandite, bel-dongrite, blandfordite, winchite, juddite and fermorite, all of which are from Indian occurrences were identified and described for the first time. Typical specimens of manganese minerals (crystals as well as massive of different varieties) have been displayed in the show-cases.

In the next cubicle we see show-cases under the heading Dharwar System, Gondite-kodurite-khondalite Series, Sausar, Sakoli and Chilpighat Series and Gangpur Series. All these along with those described above and the Aravalli System and Iron-ore Series displayed in the succeeding cubicle represent rocks some of which are as old as 2,450 million years. The Archean rocks are unfossiliferous and form the basement of all the later sedimentary rocks.

The above mentioned Syetems and Series have characteristics of their own and have been termed on a regional basis. Under the Dharwar System one will see rocks from the type area in Mysore, which contains the oldest rocks. Rocks of gondite-

Kodurite Series have their type areas in Madhya Pradesh and Andhra Pradesh, respectively. Both types of the rocks are the source rocks of the manganese ores in India. Gondite, named after the Gonds the aboriginal tribe in Madhya Pradesh, contains an assemblage of quartz, spessartite, manganese-amphiboles, piedomontite and manganese mica. Kodurite named after Kodur in Vishakhapatnam district, in Andhra Pradesh, consists of the minerals spessartite, andradite, orthoclase, apatite and manganese pyroxenes in varying proportions. The khondalites and metamorphosed sedimentary rocks mainly from Orissa and Andhra Pradesh and contain quartz, feldspar, garnet and sillimanite besides minor amounts of graphite. From these rocks are curved the beautiful images of Konarak on the Orissa coast. This rock has also been named after the aboriginal tribe known as Khonds in Orissa. The Sausar-Sakoli-Chilpighat Series of rocks are typically found in the adjacent portions of Maharashtra and Madhya Pradesh in the districts of Bilaspur, Balaghat, Nagpur, Bhandara and Chindwara; the specimens displayed are from the type areas. The Gangpur Series of rocks have their type area in the Sundargarh district of Orissa. They contain good quality limestones and dolomites which are now being utilised in iron smelting and for preparation of lime.

In the next cubicle, are displayed rocks belonging to the Aravalli System, Iron-ore-Kolhan Series, Cuddapah System and Delhi System. This show-case also contains rocks specimens from Rialo Series which include the famous marble from Makrana, Jodhpur. In the show-case displaying specimen belonging to the Iron-ore and Kolhan Series rocks typically found in Singhbhum and adjacent districts in Bihar and Orissa, such as banded hematite-quartzite, phyllites, limestones, volcanic tuff, etc., are displayed. It is in this formation that India's vast resources of high-grade iron-ore occur.

The close of the Archean era (955 million years) was followed by sedimentation in Peninsular India. Such rocks have been shown in the show-cases under the headings Cuddapah, Kurnool, Delhi and Vindhyan Systems. These formations also include rocks of igneous origin, also formed during the same period.

Within the Vindhyan System occur vast resources of good quality limestone, which is being used for the manufacture of cement. After the Vindhyan there was a gap in the geological history of Peninsular India till the upper Carboniferous times when there was extensive glaciation; and later deposits of the Gondwana System of fresh water sediments which continued till lower Cretaceous time. Representative specimens of the Gondwana System are displayed in the show-cases. The most important coal deposits of India come from the Gondwana System.

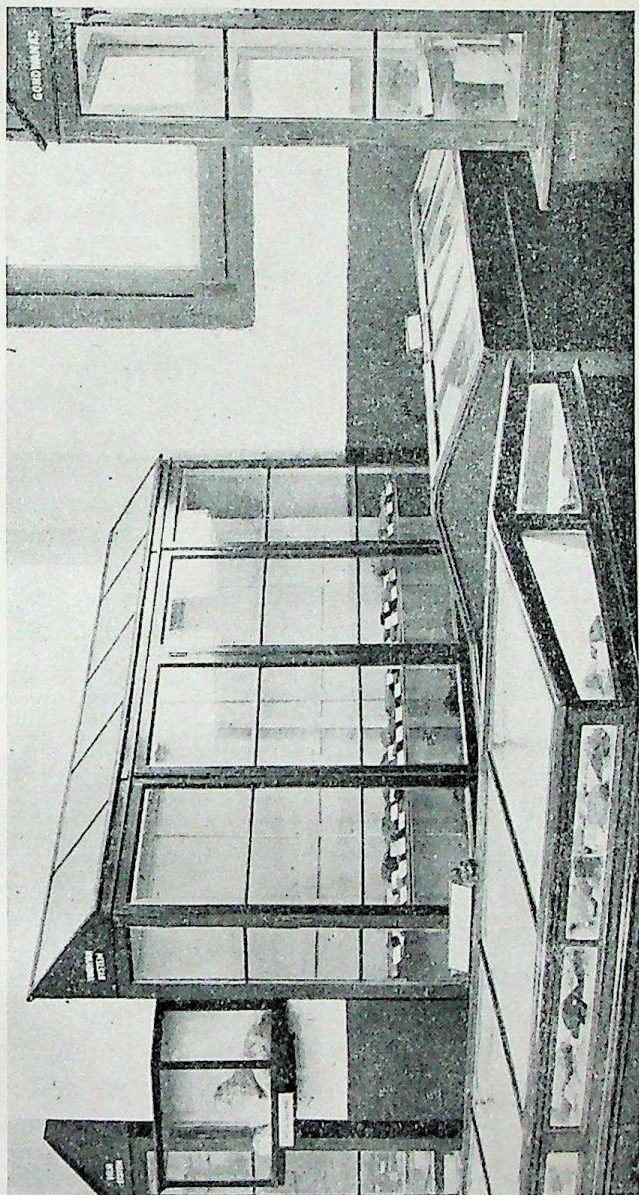
The next show-cases contain rocks formed during Mesozoic era classified into three systems—Triassic, Jurassic and Cretaceous.

The close of the Mesozoic era was marked by the outpouring of enormous lava flows which spread over 5,18,000 Sq. kms. in western, central and southern India, specimens of which have been displayed in the succeeding show-case under the term "Deccan Trap". The specimens include basalt and other volcanic rocks from different flows and from different localities.

The geological history of the Himalayan region is not entirely known. Only some areas have been studied area-wise. Specimens of rocks and minerals from the Nepal, Kumaon and Punjab Himalayas are displayed.

Within cubicles on the southern part of this gallery the minerals and rocks are arranged according to their use in industries. These show-cases are intended to display that in modern life minerals and rocks play a vital role in several different ways. The order of arrangement from west to east in mica, atomic minerals, petroleum, iron and steel, base metals, aluminium, coal, cement, chemical, refractory, abrasive, glass and ceramic and paint industries. Both the materials and finished products, are displayed along with diagrams, charts, graphs and photographs.

India produces the world's best variety of mica from Bihar. In the mica industry show-case are exhibited specimens from type areas in Bihar, Andhra Pradesh and Rajasthan. The different



Portion of the stratigraphy-wise arrangement in the background and state-wise in the foreground.

varieties of mica such as ruby mica (muscovite), lepidolite, phlogopite, biotite, etc., are on display.

This is the Atomic Age. Not only are the nuclear reactors providing perennial energy for producing electricity for running submarines, etc., but are being used also in the production of isotopes for treatment of disease, in industry and agriculture, as also in research. In the atomic minerals show-cases atomic minerals from different parts of India and abroad, such as monazite sand from Travancore, pitchblende from Gaya, torbernite from South Australia, as also other materials such as beryl from Rajasthan etc., used in atomic reactors, are displayed.

When darkness surrounds the earth, we rely on the kerosine lamp to light our houses in the villages. We also know that buses and cars run on petrol. Both kerosine and petrol are obtained from a naturally occurring oil known as petroleum which is the source of several other by-products widely used in industry. Utility of petroleum product has been illustrated by diagrams and photographs. Crude oil recently found in Ankleswar, Gujarat, has been displayed together with samples of kerosine, transformer oil, batching oil, lubricant, paraffin wax and furnace oil.

Every one is familiar with iron and steel and their uses in modern life. India has vast deposits of high grade iron ore in Bihar, Orissa, Madhya Pradesh, Madras, Andhra Pradesh and Mysore. One can see in the show-cases different varieties of iron ores such as hematite, magnetite, limonite, etc., together with other raw materials *e.g.*, coal, dolomite, limestone, magnesite, fire clay, fluorspar, manganese ore and chromite. Finished products such as bridge rail, rail, tee, square channel, angle, sheet, bar, beam and fire-bricks in India and from foreign countries, are also on display.

Base metals such as copper, lead and zinc are no less important in the modern world. All of us are familiar with alloy such as brass made of copper and zinc. Copper being a good conductor of electricity is extensively used in the electrical industry. In the show-cases are displayed ores of lead and zinc (galena and

sphalerite) from Zawar, Udaipur district, Rajasthan; ore of copper (chalcopyrite) from Singhbhum district, Bihar; different stages in the manufacture of copper such as blister copper, matte, refined copper and finished products such as brass.

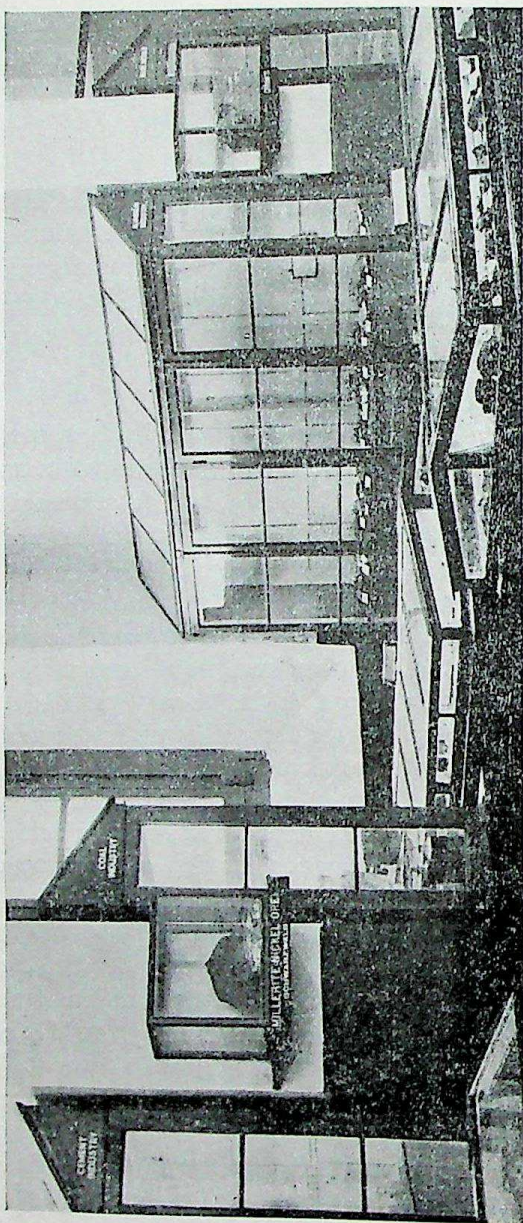
In the next show-case under aluminium industry, are exhibited aluminium ore (bauxite) from different localities in India; cryolite, essential for the extraction of aluminium; and different aluminium products including first aluminium metal produced in India on 6.3.1943 at Aluparam, Travancore district, Kerala; aluminium foils, aluminium ingot, aluminium sheets, aluminium compounds, etc.

Coal has manifold industrial uses. The railway, iron and steel industry and foundries, thermal power generating units and mills of various types are the principal industrial consumers. Displayed in the show-cases are different stages of coal formation *e.g.*, peat, lignite, bituminous coal and anthracite.

The different constituents in a banded coal specimen *viz.*, clarain, durain, fusain and vitrain have been shown. India has fairly extensive deposits of coal in the Lower Gondwanas and in the Tertiary formations. Other show-cases under the coal industry contain the various by-products of coal such as coke, ammonium sulphate, coal tar, phenol, disinfectants, motor spirit, crude benzol, benzol, pitch, touline, carbolic acid, crysylic acid, aniline dyes, etc., together with a diagram showing coal products.

Everybody is familiar with cement required in various types of constructions such as dams, bridges, buildings, roads, etc. The cement industry show-case contains specimens of limestone, clay, laterite, coal and gypsum which are used mainly in making cement.

Sulphur known to our ancients for its medicinal properties is now mainly used in the manufacture of sulphuric acid, and explosives, etc. Native sulphur in Indian territory occurs in Barren Islands. India has also deposits of pyrites (sulphide of iron), extensive deposits of which occur, at Amjor, Bihar and Chital-



Show-cases in which minerals are arranged industry-wise.

durg in Mysore. The sulphur industry show-case contains specimens from these localities as well as from different parts of India.

Phosphorous is an important element needed by plants and animals. The minerals apatite and phosphatic nodules used in the fertiliser industry, are displayed.

The chemical industry show-case contains various chemicals which are obtained from minerals.

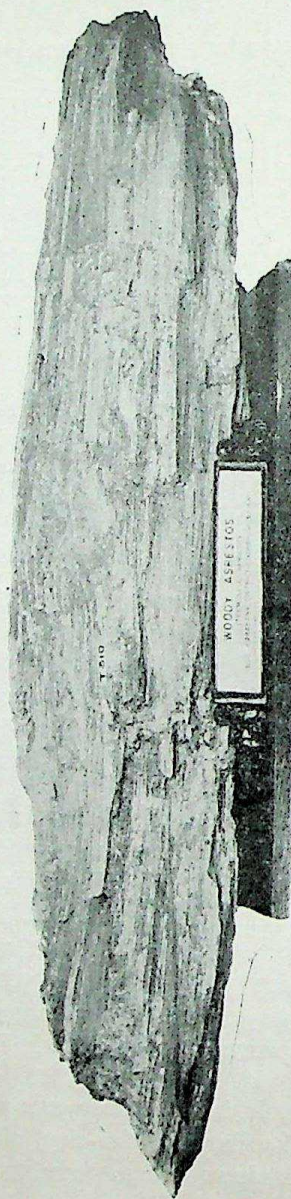
In the show-case, showing refractory minerals and rocks, raw materials used in the industry, such magnesite, silica stones (quartzite), fire clay, chromite, etc., as also finished products including silica brick, cupels, etc., are on display.

A specimen of asbestos more than 1.36 metres long and about 0.6 metres wide, from Singhbhum district, Bihar, can be mistaken for a log of wood. It is one of the largest specimens of its kind displayed in any museum in the world.

Asbestos is used extensively in the manufacture of special types of cement, heat insulator and for lining in the automobile industry. The asbestos industry show-case contains asbestos specimens from different localities in India viz., Singhbhum district Bihar and Cuddapah district Andhra Pradesh; also shown are specimens from Rhodesia. Products prepared from asbestos viz., asbestos yarn is on display.

Abrasives widely used in industry are manufactured from minerals and rocks of different kinds. Diamond which is valued as a gemstone, because of its dazzling brilliance, is also useful, for drilling hard rocks, because of its hardness. Black diamonds are used for this purpose. Corundum, garnet, quartzite, etc., are also used in drilling cutting, grinding, buffing, polishing and finishing in several different ways. Important among the exhibits are corundum, garnet and quartz from localities in India and abroad.

In the glass and ceramic industry show-case are displayed the raw materials such as kaolin, clay, fire-clay, glass sand, quartz, etc., and their finished products such as porcelain, soda lime glass, crown glass, etc.



Woody asbestos from Singhbhum district, Bihar.

The show-case displaying paint industry contains raw materials such as yellow and red ochres, clay, lime, barytes, chalk, manganese oxide, potassium dichromate, etc., which are used for the manufacture of paints.

About one-third of the rock and mineral gallery, on the eastern portion is occupied by specimens of typical minerals and rocks largely obtained from foreign countries. The minerals have been arranged according to the system of Dana, a famous Mineralogist. They are grouped under elements, oxides, silicates, carbonates, sulphides, etc. Similarly the rocks have been classified under igneous, metamorphic and sedimentary types.

A large-sized slab of slate has been displayed on the southern exit of the gallery.

The other exhibits in this gallery include a large specimen of beryl from mica-bearing pegmatite, black marble vase with mosaic of coloured marble, tin splash from Malaya, native sulphur, triplicate from pegmatite vein, manganese ore from Madhya Pradesh, zeolite from Western Ghats, dykes of periodotite intruding coal, massive garnet from Hazaribagh, jasper, reniform mass of hematite, zinc-blende from Riasi *tehsil*, Jammu, quartz crystal from Nepal, contact of mica schist with muscovite bearing pegmatite, millerite (ore of nickel), chromite from Baluchistan, calcareous graphite from Kalahandi in Orissa, white marble statue, and specimen of agate from Rajmahal Hills.

The exit from the gallery leads to the verandah where a huge fossilised trunk of *Dadoxylon* measuring about 72 feet (21.94 meters), recovered from a railway cutting near Asansol in Raniganj coal-field and some of the more important building stones have been displayed.

The building stones include large-sized specimens of slate, flagstones, marbles, sandstones, limestones, basalt, granite, potstones, laterite, charnockite, quartz, etc., which have been used for building purposes in various parts of India. Interesting among them are marbles of different colour such as white, green, gray, etc., from Makrana and Ajmer, sandstones from different geo-

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logical horizons, such as upper Bhandar, Kaimur, Barakar and Mahadeva Series, limestones of sedimentary, crystalline and shelly varieties, some of them with polished surfaces, basalt blocks from Maharashtra, laterite from Orissa and granite from Jabalpur.



A photo of the building stone collection in the varandah on the southern side of the mineral and rock gallery.

PART II

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INTRODUCTION

Fossils : It was known from the remote past that certain forms resembling sea animals occur embedded in rocks. They were first considered as "Sports of Nature" but later were found to be similar in all essential details to the hard parts of the present day animals and therefore, indicated the existence of sea in the remote past. Such remains of plants and animals of the past preserved in rocks are known as FOSSILS.

It requires a series of fortunate accidents for an organism to become a fossil. Firstly, it must be buried under certain sedimentary deposits before it is destroyed by outside agencies like air, water and organisms. Then, these deposits in turn must be converted into rocks and uplifted to form land. And finally the land surface should undergo denudation until these organic remains lie close to the surface. Even then, the fossil may lie undiscovered unless an appreciative collector happens to pick it up at the right moment. In spite of these hazards of nature, fossils do occur sometimes in large numbers enough to cater to the human curiosity and knowledge.

Fossils have great significance as they tell us the changes that took place on the earth millions of years ago. They indicate the conditions under which a particular formation was deposited and the climate of the past geological ages. But most important of all, it is possible to trace the race history or phylogeny of the animals and plants by studying the fossil forms in their stratigraphical succession. The fossil study is indispensable in the discovery and exploration of coal and petroleum.

Ancient Seas and Continents : The fossiliferous sedimentary formations fall into four major age-groups, namely, the Palaeozoic, Mesozoic, Tertiary and Quaternary. The Quaternary Era corresponds to the Great Ice Age, when glaciers were present right up to the foot of the Himalayas. The Eras are subdivided into systems—Cambrian, Ordovician, Silurian, etc. (see Table I).

QUATERNARY	Holocene Pleistocene	
TERTIARY	Pliocene Miocene Oligocene Eocene Palaeocene	1,000,000
MESOZOIC	Cretaceous Jurassic Triassic	70,000,000
PALAEOZOIC	Permian Carboniferous Devonian Silurian Ordovician Cambrian	225,000,000
		600,000,000

Table I. The Geological Time Scale.

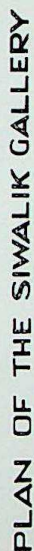
On the basis of the study of fossils it is deduced that an ancient sea known as the 'Tethys' was in existence in the region which now more or less corresponds to the Himalayan chain of mountains, particularly its northern borders. This sea extended from China to Spain separating two major continents, one to its north, the Angara-land, and the other to the south, the Gondwana-land (so named after the Gond Kingdom in Madhya Pradesh). During this era India, South America, Africa and Australia formed one continuous landmass of the Gondwanaland, whose sedimentary rocks are classified into the Gondwana system. The coal deposits of India were formed in this continent during Gondwana times, while the marine fossils lived in the Tethys sea.

The plants, mostly the representatives of an ancient vegetation, flourished during the Gondwana epoch, approximately between 270

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and 135 million years ago. The Gondwana epoch was initiated by a widespread glaciation over the entire southern continent. More or less contemporaneous with the glaciation was the advent of the Glossopteris or the Lower Gondwana flora, distinct from the floras that flourished elsewhere in the world during the same geological epoch. The glacial conditions persisted for a period of about ten million years. When the climate gradually became less rigorous, the Glossopteris flora began to flourish in all luxuriance. Desert conditions then followed which brought the temperate Glossopteris flora to a total extinction. The Ptilophyllum or the Upper Gondwana flora that followed in the wake of the dry period thrived in a warm, humid climate, to be replaced before long by floras of a more modern aspect. Gondwana-land persisted as a more or less continuous landmass for nearly 200 million years but began to break up during the early part of the Cretaceous period.

The Tertiary Era was a period of genial climate and luxuriant vegetation in which many large vertebrate animals flourished without much competition. Their remains were entombed in the Siwalik rocks, which are deposits, laid by rivers in the area which now constitutes the Siwalik hills.

During the Pleistocene period which corresponds to the Great Ice Age and which followed the Tertiary, the northern part of India was covered by glaciers and the entire continent experienced the rigors of extreme cold, which led to the extermination of many of the Tertiary vertebrates.





FOSSIL GALLERIES

A rich collection of fossils accredited to the work of the officers of the Geological Survey of India for a period of over a hundred years is exhibited in two large halls, the Siwalik Gallery (Pl. II) and the Invertebrate Fossil Gallery (Pl. VII).

In the Siwalik Gallery, situated on the ground floor, are exhibited fossil remains of the large vertebrate animals that lived in India during the Tertiary and Pleistocene times, that is, during the last 70,000,000 years or so.

The Invertebrate Fossil Gallery occupies the northern wing of the first floor and houses a vast collection of invertebrate fossils, plant remains and a few vertebrates. The fossils are arranged according to their stratigraphic, that is, chronological order, in the ground show-cases and represent a record of life during the past 600,000,000 years.

In addition to fossils from India and adjacent countries, fine collections of vertebrate, invertebrate and plant fossils from foreign countries, mostly European, are also exhibited in the two galleries.

THE SIWALIK GALLERY

Life during the Siwalik period : Before dealing with the Siwalik exhibits (Plate I) it is necessary to know the varied life that flourished in India during the Tertiary Era.

The earliest record of mammals in India dating back to 70,000,000 years, is from the Eocene of north-west Punjab, and includes a few hoofed quadrupeds and primitive carnivores or flesh-eating animals. However, in the succeeding Oligocene and Miocene periods, many highly developed forms came into prominence as for example, the coal beasts and giant rhinoceros. These animals inhabited the region of the present Bugti Hills of Baluchistan, about 40,000,000 years ago. Among them, the giant *Baluchitherium* ("the beast of Baluchistan") is of much interest. The fossil remains of this animal indicate that it rivalled

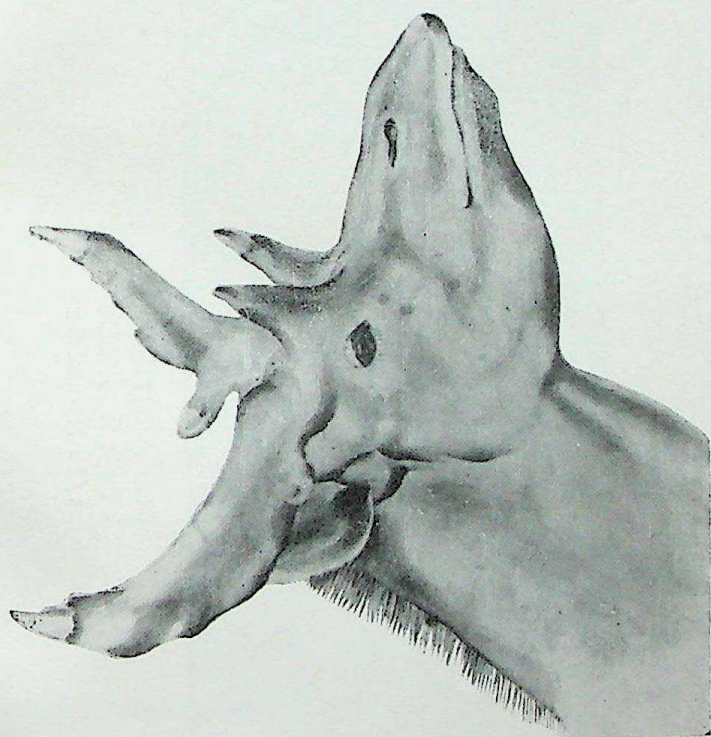
the elephant in size, with massive pillar-like limbs, a horse-like neck six feet in length, and a head resembling that of a camel. A photograph of this animal is exhibited in the wall-case No. 12 on the eastern side.

Another group of animals that roamed the Siwalik forests is the giraffe. To-day these are confined to the African continent, but in the past there lived in India at least four different members of this group, namely *Vishnutherium*, *Sivatherium*, *Bramatherium* and *Hydaspitherium*. Of these forms, the one that requires particular mention is *Sivatherium*, (Plate III) a restoration of which is exhibited in the gallery. This animal had the body and limbs resembling that of a giraffe (though the animal had a short neck) while the horns were like those of an antelope.

In the Siwalik forests there lived several varieties of horses, the ancestors of our modern horse. They had three toes instead of one as at present. The evolution of the horse is illustrated in the series of drawings exhibited above the wall case against the eastern wall. The actual three-toed hoof of the horse (*Hipparion*) is exhibited in show-case No. 11 Even more interesting animals of the past are the elephants. The earliest representative of this group is *Moeritherium* which lived about 15,000,000 years ago. It was a small animal resembling a pig in size, without any visible trunk or tusks. Its rendezvous was near swamps and it fed on marshy succulent vegetation. The successors of this primitive form gradually increased in size and developed an elongated skull, ridged teeth and a trunk. A few forms like *Deinotherium* had the lower jaw elongated while the incisors were turned downwards and backwards. As evolution progressed, the elephants developed tusks only in the upper jaw with the trunk increasing greatly in size. One such giant form which was common in Siwalik times is the well-known and very characteristic elephant, *Stegodon ganesa*. All these forms became extinct. The evolution of the elephant depicted in a chart is exhibited above the wall case on the eastern side.

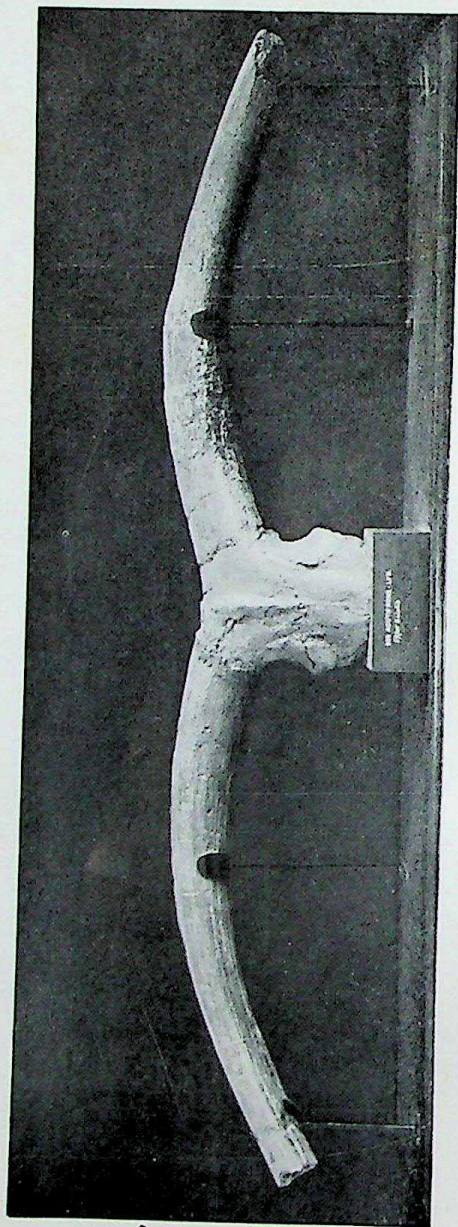
Besides the horses and elephants, the Siwalik period abounded in hippopotamus, pigs and bovids (cattle). The bovid horns

PLATE III



SIVATHERIUM
(An extinct Giraffe)

PLATE IV



BOS ACUTIFRONS
(A large Siwalik Bovid)
1/10 Natural Size

attained enormous dimensions, in some cases measuring as much as seven feet, as in *Bos acutifrons*, one of the largest Siwalik bovids (Pl. IV). These animals were represented by many more species than known at present. Their remains are exhibited in various show-cases.

Coming to the biologically higher forms, there were several tail-less apes known as the Anthropoid (i.e. man-like) apes. Some of these forms like *Sivapithecus*, *Sugrивapithecus* and *Ramapithecus*, showed several progressive characters, particularly in their dentition. These apes have left behind the hard parts of their skeletons in the form of jaws and teeth, which have been found entombed in the rocks of the Siwalik hills as fossils.

At the main entrance to the gallery a series of skeletons, or their casts, are arranged in the central row. The finest exhibit in this series is the skull of the long-tusked elephant, *Stegodon ganesa*. This gigantic animal has been named after the Hindu deity GANESA, believed to have possessed the head of an elephant. It was one of the largest elephants recorded from India, with tusks measuring over ten feet in length and two feet in circumference. Its remains were discovered in the Siwalik hills near Simla.

Immediately behind this giant of the forest, stands the fragile skeleton of the New Zealand flightless bird, *Dinornis elephantopus* (Pl. V), which became extinct in the recent past.

Behind this bird, in the same row, is the cast of the queer looking tortoise-like animal, *Glyptodon typus*, a relative of the anteaters. The body of this slow-moving, inoffensive, herbivorous animal was covered by thick bony plates making it invulnerable against attacks of the sabre-toothed tigers which abounded in those days.

This is followed by a few reconstructed skulls and photographs of the extinct representatives of the giraffe family, for example, *Sivatherium* and *Bramatherium*, named after the well known Hindu deities. These animals possessed two pairs of horns and combined the characters of more than one type of animal.

Next to these, are three skulls of extinct representatives of the elephant, namely, *Stegodon* with unusually long tusks, *Deinotherium* with jaws and tusks bent downward, and a massive skull of *Palaeoloxodon namadicus* an immediate ancestor of the Indian elephant, discovered in the Narbada alluvium.

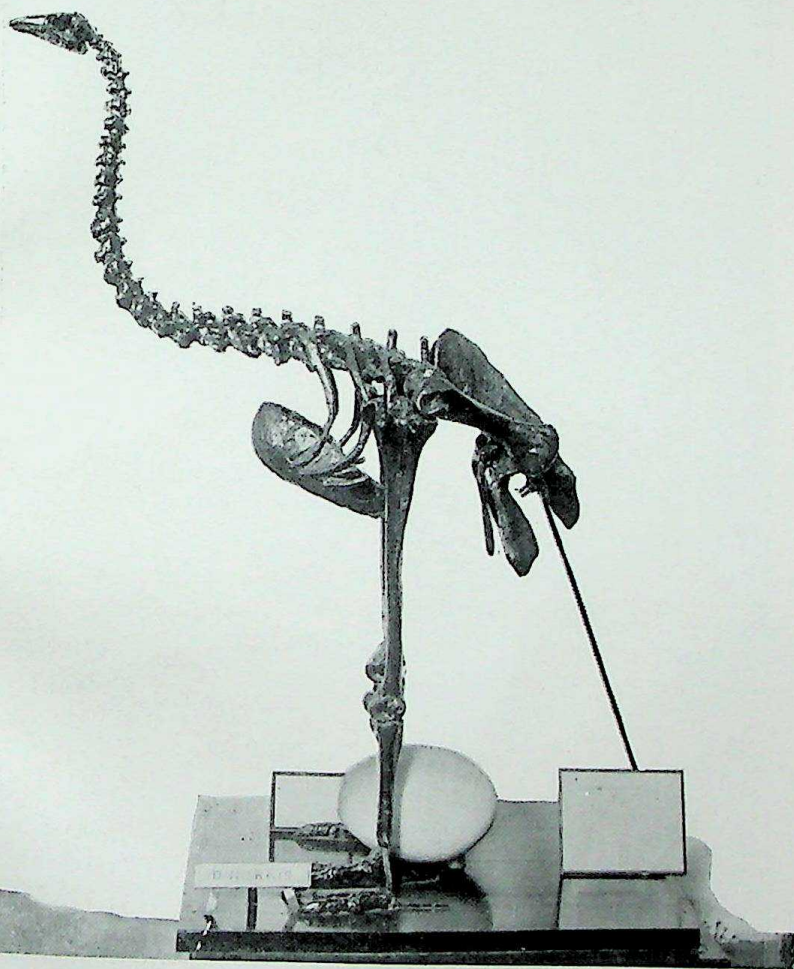
Passing on to the floor cases on the western side in show-case I, are exhibited the comparatively recent (Pleistocene) fossils from the Karnul Cave deposits. The cranium, jaws and dentition belonging to several groups of animals like pig, rhinoceros, hyaena, horse and cattle were found in these caves.

The next four show-cases (2 to 5) contain reptilian remains, mostly turtles, tortoises and crocodiles. One of the most interesting fossil tortoises known from the Siwalik hills is *Colossochelys atlas* which lived during the Pleistocene times. This species was of such enormous size that a man could lie with ease inside its skeleton. A restored model (Pl. VI) of this huge tortoise is exhibited in the Invertebrate Fossil gallery on the first floor.

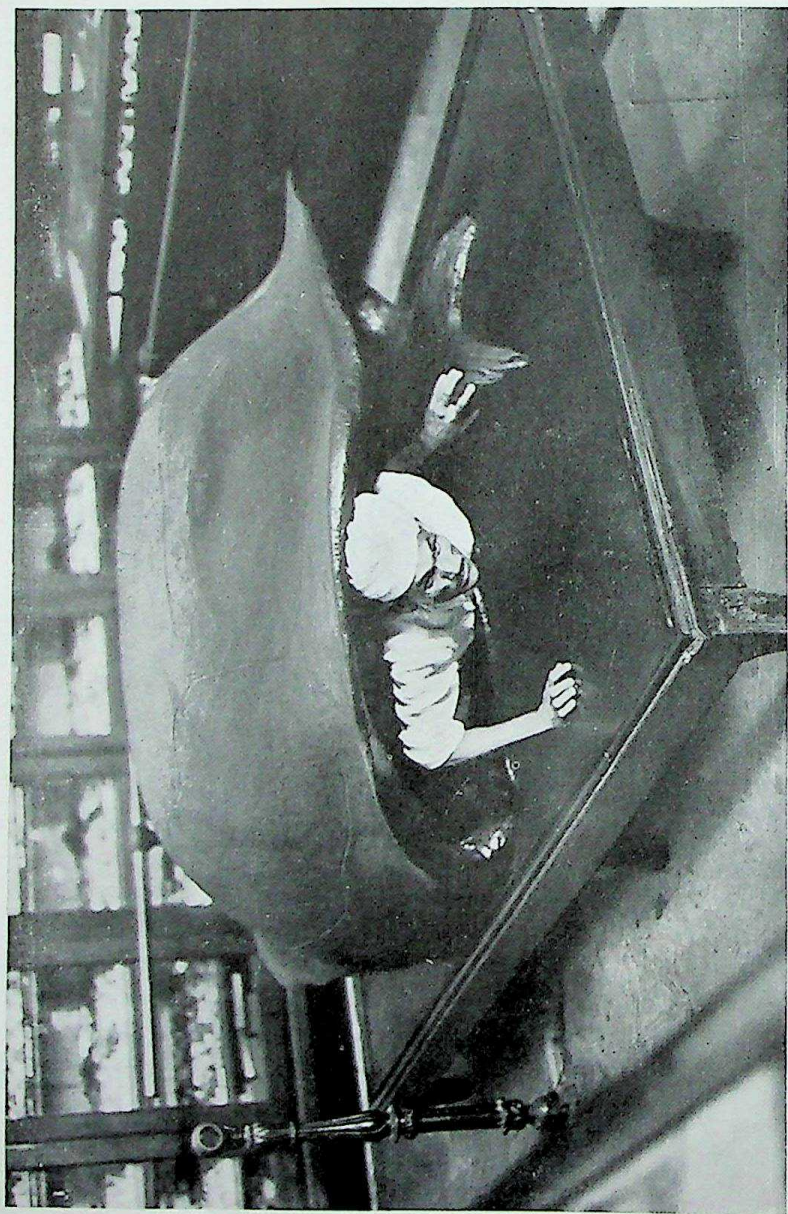
The succeeding two show-cases (6 and 7) at the southern end contain the carnivorous animals which flourished during the Siwalik times. Some of the interesting forms whose remains are on view, are the bear-like dog, *Amphicyon*, the Indian sloth-bear, *Melursus* and a primitive bear-like carnivore, *Agriotherium*. Besides these, are exhibited the fossil remains of *Lutra* (Otters), *Ictitherium*, (Civet cats), *Mellivora* (Badger) and *Hyaena*. A fragment of the canine tooth of *Machaerodus* (sabre-toothed tiger) which had canine teeth nearly nine inches long in the upper jaw is exhibited.

On the eastern side, in show-cases 8 to 10, may be seen several genera of the extinct predecessors of the rhinoceros family such as *Aceratherium* (hornless), *Diceratherium* (with two horns) and *Teleoceras* (water-loving). One of the most interesting forms is *Baluchitherium* which rivalled the elephant in size and lived during the Oligocene-Miocene times.

PLATE V



DINORNIS ELEPHANTOPUS
(An extinct flightless Bird)
1/10 Natural Size



COLOSSOCHELYS ATLAS
(A giant Tortoise of the past)

In the adjacent two show-cases (11 and 12) will be found fossil remains of the horse. In India, only two links in the evolution of the horse are known. The more interesting of these is *Hipparion*, a three-toed horse and *Equus*, the ancestor of the modern Indian horse. *Hipparion* was originally an inhabitant of North America and later migrated to India and other continents during Pliocene times. The teeth and toes of this horse are exhibited here.

Of great interest are the modest skeletons of a very ancient group of animals, the *Titanotheres*, exhibited in the show-case 13. Fossil records of these odd-toed, hoofed animals are known from North America, Asia and Europe. The early forms were small but their later descendants rivalled the elephant in size. Some of these, like *Sivatitanops* and *Eotitanops*, were peculiar to the Burmese region. A relief model of a Titanotheres in its natural habitat is placed on the wall-case 12 on the eastern side. The dentition of another group of animals belonging to the order Chalicotheridae is also exhibited in the show-case 13. One of the most interesting forms is *Nestoritherium* which had a horse-like neck, the hind-limbs slightly smaller than the fore-limbs and with clawed digits.

On the eastern side, in show-cases 14 to 16, are housed a series of jaws of the pig family representing various stages in their evolution from the simplest, *Conohyus*, to the most complex *Sus*. The geological record and abundance of these forms indicate that the Indian region was one of the centres of evolution of this group of vertebrates. Mention may also be made of the form, *Tetracodon* of *mirabilis*, one of the largest known pigs which had massive cone-like premolars.

Show-case 17 contains the fossil remains of hippopotamus. At least two interesting forms, *Hippopotamus sivalensis* and *Hexaprotodon sivalensis*, are known from the Siwaliks. Of these, *Hexaprotodon sivalensis* possessed six cutting teeth, a character considered to be primitive.

Then, there are the extinct coal beasts, the Anthracotheres, combining characters of both the pigs and the hippopotamus. All

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of them possessed four to five separate toes and lived near swamps
on marshy vegetation. In India, many representatives of this
family have been found as fossils, e.g., *Merycopotamus*. But the
more primitive forms such as *Anthracothema* and *Anthracohyus*
come from Burma.

Fossil remains of the giraffe family are exhibited in show-cases
22 to 24. As already pointed out, India was one of the centres
of evolution of the giraffes. *Giraffokeryx* is one of the early
giraffes with four horns. Later forms like *Bramatherium* and
Sivatherium were larger in size and had highly developed frontal
and parietal horns. They also possessed large teeth, massive
limbs and a short face.

The adjoining show-cases (25 and 26) house the remains of
the Siwalik cattle (Bovidae). Siwalik cattle were of far greater
variety during Upper Tertiary times than they are to-day.
Skulls, horn-cores and teeth of several Siwalik Bovidae are ex-
hibited here.

In the last two show-cases (27 and 28) are exhibited the den-
titions of a few Mastodon-like forms of elephants. Among the
Siwalik mammals, the elephants form one of the most inter-
esting groups and their remains are found in great abundance
in the Siwalik rocks. The exhibits include dentitions of *Deino-*
therium, *Stegolophodon*, *Tetralophodon*, *Stegodon clifti*, *S. in-*
signis, *Hypselephas hysudricus* and *Loxodon planifrons*.

Passing on to the wall-cases on the eastern side, are Nos. 1 to
11 where large skulls of the fossil representatives of the elephant
group are exhibited, while Nos. 12 to 18 contain the skeletal re-
mains of *Rhinoceros*, *Baluchitherium* and *Paraceratherium*,
Hippopotamus, *Bos acutifrons*, etc.

In wall-cases 19 and 20, at the southern entrance, there are
large fossil specimens of turtles and crocodiles. Adjacent to
them (21 and 22) a foreign collection of fossil birds is exhibited.
These are mostly in the form of vertebrae, limb-bones, etc.,
belonging to the group *Dinornis* and *Cnemioornis*. The western

wall-case 23 contains foreign fossil carnivora such as *Amphicyon*, *Hyaenodon*, *Canis* (dog) and *Vulpes* (wolf). The next show-case 24, houses the skulls of some of the giant Titanotheres and also remains of *Aceratherium*, a hornless rhinoceros. Wall-case 25 is mainly devoted to specimens belonging to the family Equidae ranging from the earliest *Eohippus* (Lower Eocene) to *Equus* (Pleistocene). They come from two widely separated localities in Europe and North America. Wall-case 26, contains the dentition of *Tapirus priscus*, from the Upper Miocene beds. It was a small herbivorous animal with a flexible, elongated proboscis and small tusks. Besides these, lower jaw of *Metamynodon* from the Oligocene, the lower molar of *Elephas* and the mandible of *Hippopotamus* are on view. The other interesting exhibits are the cranium of *Oreodon* from North America, *Colodon dakotensis*, *Poebrotherium*, *Agriochoerus antiquus* and *Elotherium mortoni*.

Wall-case 27 contains the cranium of *Castoroides ohionensis* a giant beaver (as large as a bear) from the Pleistocene deposits. The remains of *Megalonyx*, one of the giant ground sloths, may also be seen here. The sloths were slow-moving animals with enormous claws (used for digging roots) and roamed the forests east of the river Mississippi. The other exhibits include the remains of *Glyptodon*, *Scelidotherium* and fossil whale, *Zeuglodon*. Wall-case 28 contains the cranium of *Nototherium*, a marsupiale, *Halitherium* (sea-cow) and *Toxodon angustidens*, (large ungulate resembling a guinea pig).

In the south-western corner of the gallery are exhibited a rare collection of Anthropoid apes (Primates) from the Siwalik hills. The dentition of these fossil apes indicates many progressive characters. The main exhibits include the dentitions of *Sivapithecus*, *Sugrивapithecus*, *Bramapithecus* and *Ramapithecus*.

There is a small show-case containing one of the most important and interesting exhibits, at the north-western corner in which are placed the casts of skulls of some early men. The more important ones are the Java Man, the Peking Man, and the Heidelberg Man (jaw only). It is of interest to note that in this vast

country of ours no fossil remains of Man more primitive than the modern Man (*Homo sapiens*) have so far been found.

THE INVERTEBRATE FOSSIL GALLERY

Sea animals of past ages : We shall now deal with the varied life of past ages whose remains are preserved as fossils extending back to the very dawn of Geological History, millions upon millions of years ago.

Pre-Cambrian group (show-case 21)

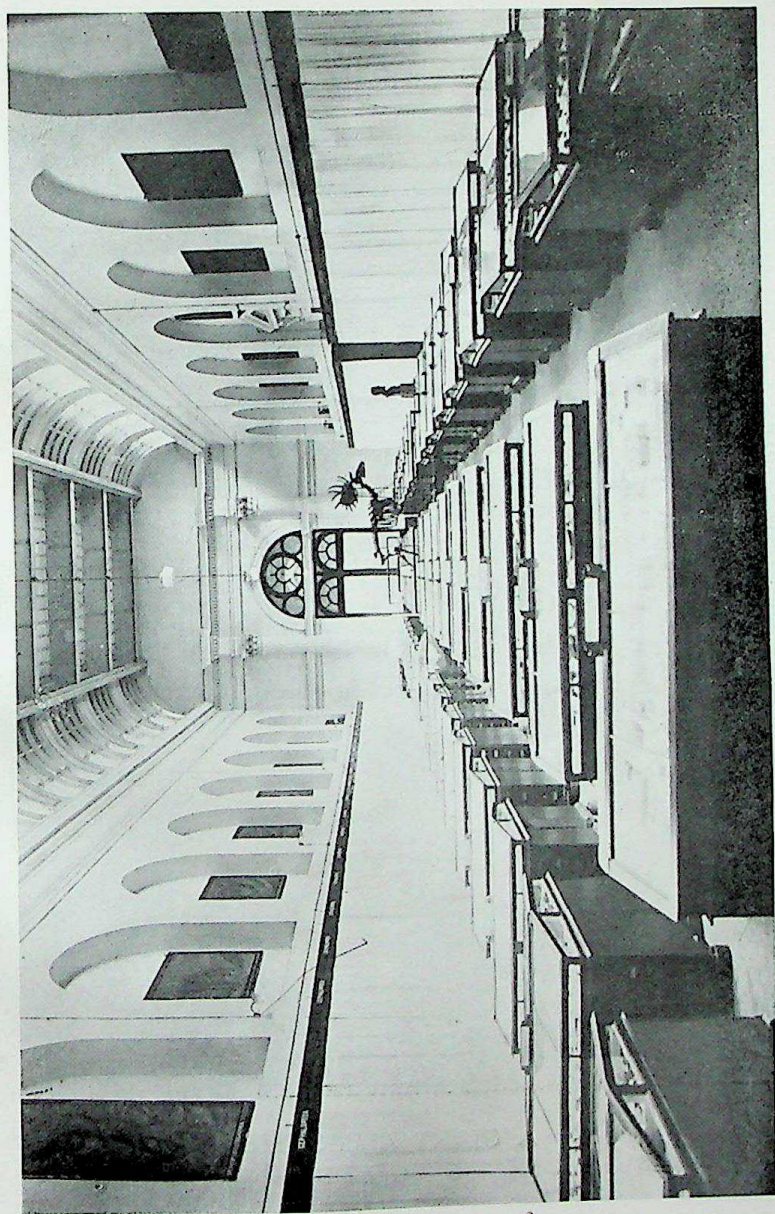
As the visitor enters the gallery, he finds the earliest organic remains so far found in India (from the Vindhyan formation, presumed to be of Pre-Cambrian age) exhibited in the show-case immediately to the left. These date back more than 600,000,000 years. The remains consist of small rounded disc-like organisms found in the dark coloured Suket Shales of Vindhyan age, and the name *Fermoria* has been given to them. Many palaeontologists from India and abroad have studied these important fossils, but their correct biological position is still an unsolved puzzle.

Palaeozoic group (show-cases 21 to 47)

Fossils belonging to the Palaeozoic era, obtained from the Salt Range, Kashmir, Spiti, Central Himalayas and the Shan States of Burma, are exhibited in these twenty seven show-cases. It is interesting to make the acquaintance of the primitive Brachiopods, Gastropods and the Trilobites from the Cambrian of the Salt Range in show-case 21. Trilobites are important fossils from the Palaeozoic strata of India and Burma. They survived through 300,000,000 years and became extinct at the close of the Palaeozoic era so that, not one of their race is found to-day, except as fossils. Their near living relatives are the insects and the scorpions.

Another very ancient fossil group is the Graptolites (Hydrozoa), which are animals but look like small branches of a plant. A fine collection of Silurian Graptolites from the Shan States of Burma is displayed in show-cases 28 to 30. Representatives of

PLATE VII



INVERTEBRATE FOSSIL GALLERY

PLATE VIII



A GIANT AMMONITE
1/6 Natural Size

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this group have not been found in India so far. They survived through 180,000,000 years and became extinct in late Silurian times.

Numerous varieties of Devonian Corals from Burma are of great interest and are exhibited in show-cases 32 to 34.

One of the world's best known Permo-Carboniferous successions is found in the Salt Range and the fossil wealth of the *Productus* Limestone of that area is evidence of the wonderful variety of organisms that lived in those times. The great variety of brachiopods, crinoids and corals of the *Productus* Limestone may be seen in show-cases 38 to 43. The corals of millions of years ago built the same type of reef as do the modern corals.

Mesozoic Group (show-cases 48 to 84)

The Mesozoic era was marked by the appearance of mammals and other important groups of vertebrates. Several groups of invertebrates also became predominant during the earlier part of the era. These include the ammonites to which belong the famous SALIGRAMS, held sacred by the Hindus. Like the Trilobites and the Graptolites, the group to which the Saligrams belong became practically extinct towards the close of the Mesozoic era after a lapse of 350,000,000 years except for a single genus surviving to-day. This is the well known *Nautilus*, representations of which are sculptured at the four corners of the India Gate at New Delhi.

The ammonites from the Trias of Spiti are interesting. The beautiful *Ceratites* with their varied types of suture lines seen on the surface of the shell, catch the eye. The Jurassic system of Cutch is noted for its fossil wealth in corals and ammonites. Particular attention is drawn to the fine collection of Upper Cretaceous fossils from the Trichinopoly area, Madras (show-cases 74 to 82). Fossil molluscs and ammonites constitute the bulk of the assemblage. Some ammonites attained a diameter of about four feet (Plate VIII) (specimens exhibited against the eastern wall) and it is known that even larger specimens exist.

Impressions of fossil frogs from the Intertrappean shales of the Worli hill, Bombay, are interesting exhibits in show-cases 85 to 87. These, however, are vertebrates and belong to the group of Amphibians.

Mollusca are the important invertebrate fossils of the Tertiary fauna. The Pegu series of Burma yield a good variety of these forms and are exhibited in show-cases 96 and 97. A set of sub-Recent forms found on the Indian sea coast is also displayed to provide a contrast with their fossilised representatives. Lamelli-branchs and gastropods embedded in clay nodules of Pliocene age from Baluchistan are interesting as they explain an unusual mode of fossilisation.

Some selected specimens (show-cases 104 and 105)

Here are exhibited a fossil snake (Pl. IX) from the oil-shales of Burma, a fossil tortoise (Pl. X) from the Intertrappeans of Bombay and a fossil crab from the Miocene of Cutch. Of these only the crab belong to the Invertebrate group.

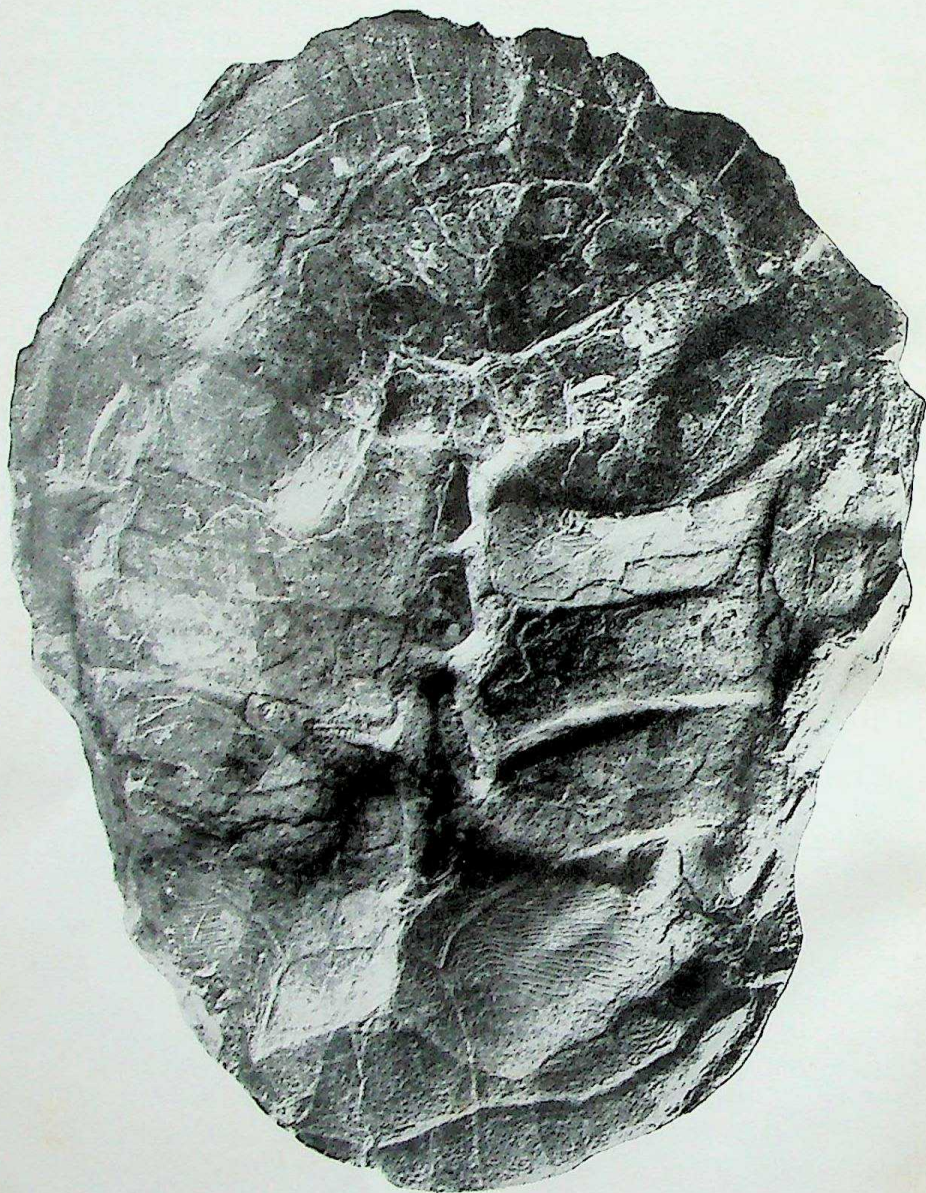
At the entrance to the gallery is placed on a pedestal a complete skeleton of the Irish Elk from the Pleistocene deposits of Ireland. Behind this is the cast of the giant tortoise (Plate VI) from the Pliocene deposits of the Siwalik Hills, to which a reference has already been made.

Evolution of Cephalopods (show-case 107)

The Cephalopods (which include ammonites) flourished during the Palaeozoic and Mesozoic times. They commenced life as straight conical forms but soon began to show a tendency to coil, ultimately becoming completely coiled. They then began to uncoil and, finally, by gradual stages, assumed the straight conical form of their ancestors. This process, however, took millions of years to accomplish, at the end of which they all died out.



FOSSIL SNAKE •
2/3 Natural Size •



•FOSSIL TORTOISE
Natural Size

Foraminifera

Representing the single-celled Protozoa are important constituents of the Cretaceous and Tertiary fauna of the Indian sub-continent. They are best developed in Sind, Baluchistan, Cutch, Rajasthan and South Indian areas. Foraminifers are used as guides for locating oil-bearing rocks underneath the surface. The last two show-cases, 108 and 109, contain large scale models of some of the more common genera of foraminifera. A few models of radiolaria are also kept in here.

Other classified collections

The show cases against the two walls contain foreign collections of invertebrate and plant fossils. The fossils constitute some of the famous collections acquired from Klipstein (1868), Geinitz (1868), Krantz (1868) and Lommel (1869). These large number of interesting collections are arranged in their biological order such as Brachiopods, Lamellibranchs, Ammonites, etc.

Plant life of the past

The plant fossils are housed in the middle row of floor cases in the western half of the Invertebrate Fossil Gallery and the foreign specimens are accommodated in the southern wall-cases.

A few typical Lower Gondwana plant fossils (Pl. XI) exhibited in the floor-cases 2 to 13 may be briefly mentioned here. One of the best known among these is *Glossopteris*, a large tongue-shaped frond. The genus *Gangamopteris* is also a common form. Its characters are similar to those of *Glossopteris* except for the absence of the mid-rib. Another form, *Noeggerathiopsis* is characterised by strap-shaped long leaves with parallel bifurcating veins and rounded apex. These leaves probably belonged to the large fossilised tree-trunks which are commonly met with in the coalfields and are known under the name *Dadoxylon*.

The exhibits kept in the floor-cases 14 to 19 are representatives of the Upper Gondwana or the Ptilophyllum flora. The fronds of

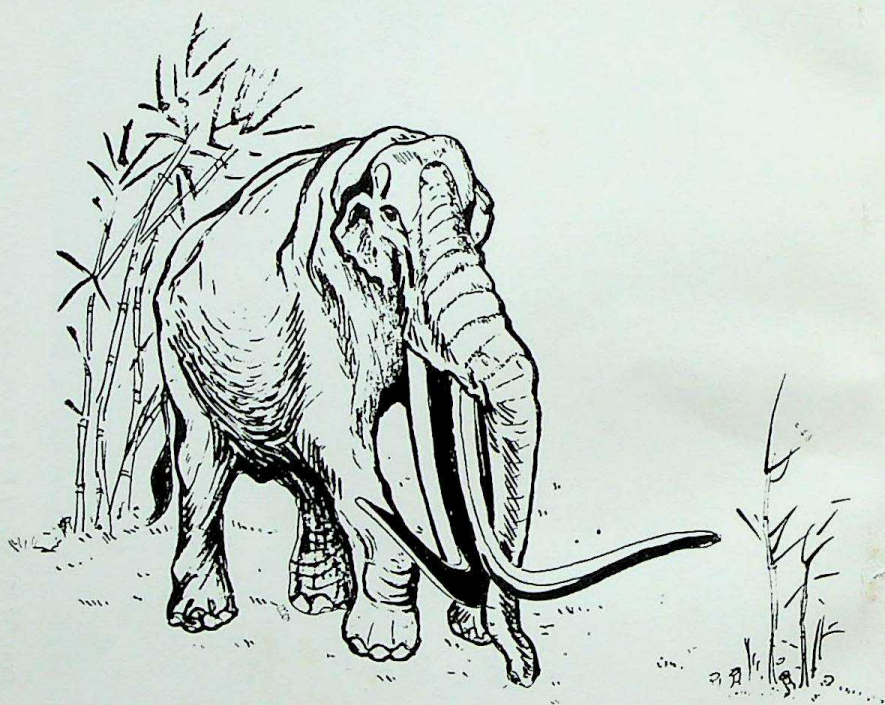
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Ptilophyllum were borne on the stems referred to as *Bucklandia*, which also gave rise to flowers of the *Williamsonia* type. Another common form is the Coniferous shoot *Elatocladus* with small narrow linear leaves having a prominent mid-rib and attached spirally on slender axis.

In the floor-case 20, some specimens of Angiosperm (flowering plant) remains are kept, where fossil Dicotyledonous wood and leaf impressions of a more modern aspect are to be seen. A specimen of a silicified Monocotyledonous wood is also exhibited. These floras flourished in great luxuriance after the break up of Gondwana-land at the close of the Cretaceous times and continued more or less without much change up to the present day.

It will be of special interest to see the large specimen of gymnospermous fossil wood (*Dadoxylon*) measuring about 80 feet in length, exhibited in the verandah on the ground floor near the Rock and Mineral Gallery.



SOME TYPICAL LOWER GONDWANA PLANTS



STEGODON GANESA

E R R A T A

<u>Page</u>	<u>Para</u>	<u>Line</u>	<u>For</u>	<u>Please read</u>
PART I	—		S. N. P. SRIVASTAVA M. V. N. MURTHY A. DUBE	M. V. N. MURTHY S. N. P. SRIVASTAVA, A. DUBE
8	—	9	and Ankleshwar, Canada-India Reactor	and Ankleshwar, (iii) Canada India Reactor
12	—	5	STORES	STONES
13	—	1	South-eastern	south-eastern
16	1	3	Over 60,000 rocks and 20,000 minerals	Over 60,000 rock specimens and 20,000 mineral specimens
18	2	3	Archaen	Archaean
19	—	9	and	are
19	—	12	curved	carved
19	2	3	rocks	rock
20	3	2	5,18000	5,18,000
20	5	5	in	is
20	6	1	word's	world's
23	6	5	Amjor, Bihar	Amjor in Bihar
25	4	2	such magnesite	such as magnesite
25	6	2	automobile	automobile
25	7	6	drilling cutting	drilling, cutting
PART II				
34	1	12	fossils	forms
38	3	19	No. 11,	No. 11.
43	2	24	marsupiale	marsupial
47	1	1	called	celled

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